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Published in:
European Review of Private Law

Publication date:
2018

Document Version
Peer reviewed version

[Link to publication in Tilburg University Research Portal](#)

Citation for published version (APA):
Tjong Tjin Tai, E. (2018). Force majeure and excuses in smart contracts. *European Review of Private Law*, 26(6), 787-804.

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Force Majeure and Excuses in Smart Contracts

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1. Introduction

Smart contracts are an exciting development at the junction of computer programs and contracts. The main advantage of smart contracts is said to be the automatic performance of the obligations, which is thereby guaranteed due to the absence of human intervention once the contract is accepted and started. However, it is possible that smart contracts do not fare well when it comes to ensuring the protection of party interests in all cases that traditional contracts do.¹ In this article I will examine whether smart contracts can allow for excuses for breach of contract. For reasons of space I will not discuss the related doctrines of withholding performance² and hardship (unforeseen circumstances).

First I will briefly introduce smart contracts and highlight a few important aspects (s. 2). Next I will provide a comparative overview of excuses, culminating in a 'common core' of the rules of various jurisdictions, inspired by the DCFR (s. 3). Subsequently I will discuss whether and how excuses can be dealt with in smart contracts (s. 4).

2. Characteristics of smart contracts

Smart contracts have by now been covered by a number of articles and reports.³ Smart contracts are in essence programs that perform part of the contractual obligations, and

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¹ See also T.F.E. TJONG TJIN TAI, 'Juridische aspecten van blockchain en smart contracts', *Tijdschrift voor Privaatrecht* 2017 (54), p. 563-608, 'Smart contracts en het recht', *Nederlands Juristenblad* 2017/146, p. 176-182.

² On which see, T.F.E. TJONG TJIN TAI, 'Formalizing contract law for smart contracts', ICAIL 2017, www.cs.bath.ac.uk/smartlaw2017/papers/SmartLaw2017_paper_1.pdf, <https://ssrn.com/abstract=3038800>.

³ Most relevant: C.L. REYES, 'Conceptualizing Cryptolaw', *Nebraska L. Rev.* 2017 (96), p. 384-445, K. WERBACH & N. CORNELL, 'Contracts Ex Machina', *Duke L.J.* 2017 (67), p. 313-382, M. RASKIN, 'The Law and Legality of Smart Contracts', *Georgetown Technology Review* 2017/1, p. 305-341, A. SAVELYEV, 'Contract Law 2.0: «Smart» Contracts As the Beginning of the End of Classic Contract Law', ssrn.com/abstract=2885241 (2016), M.L. PERUGINI & P. DAL CHECCO, 'Smart Contracts: A Preliminary Evaluation', ssrn.com/abstract=2729548 (2015), P. PAECH, 'The Governance of Blockchain Financial Networks', *Modern Law Review* 2017 (80), p. 1072-1100, E. MIK, 'Smart

may contain and execute contractual conditions, as well as invoke physical remedies (such as withholding access to a room, interrupting the starter of a car). Although discussed before bitcoin,⁴ smart contracts were found to be only feasible in a restricted environments (in particular the financial sector). With the advent of bitcoin, a cheap and secure way has become available for actually performing payments. A payment transaction is in essence a simple instruction. The computers that are part of a blockchain network can also execute highly complex programs and instructions. Blockchain technology can thus be adapted fairly easy to process complex transactions. Thereby it is possible to model complete contracts.⁵ At present the most popular system is Ethereum, which offers a fully capable computer language, Solidity, for programming contracts.

The paradigmatic way to use smart contracts in a smart contract system is that a user proposes a specific smart contract by making it available in the system. The contract has an identification number (id) and functions as an autonomous entity within the system, somewhat similar to how a website may operate on the Internet. Another user may then ‘accept’ the contract by communicating to it in some way, for example by making a nominal payment to it.⁶ The users or parties to the contract can communicate with and by means of the contract, for example by signaling that a physical package has been received, after which the contract automatically executes the payment for the package.⁷

Contracts: Terminology, Technical Limitations and Real World Complexity’, *Journal of Law, Innovation and Technology* 2017/2, p. 269-300, JEREMY M. SKLAROFF, ‘Smart Contracts and the Cost of Inflexibility’, *Univ. Pennsylvania L. Rev.* 2017 (166), p. 263-303, A.J. CASEY & A. NIBLETT, ‘Self-Driving Contracts’, *Journal of Corporation Law* 2017 (43), p. 1-33.

⁴ For example N. SZABO, ‘Formalizing and Securing Relationships on Public Networks’, 2 *First Monday* 1997(9), at firstmonday.org/ojs/index.php/fm/article/view/548/469/, N. SZABO, ‘The Idea of Smart Contracts’, at szabo.best.vwh.net/smart_contracts_idea.html, S. PEYTON JONES, J.-M. EBER & J. SEWARD, ‘Composing Contracts: An Adventure in Financial Engineering’, in *ACM SIGPLAN International Conference on Functional Programming (ICFP)* 2000, 280-292, H. SURDEN, ‘Computable Contracts’, *UC Davis Law Review* 2012, 629-700.

⁵ S.M. MCJOHN & I. MCJOHN, ‘The Commercial Law of Bitcoin and Blockchain Transactions’, Suffolk University Law School Research Paper No. 16-13, at: <https://ssrn.com/abstract=2874463>, point out that smart contracts actually resemble letters of credit.

⁶ If the contract obliges one of the parties to pay a certain amount, the contract usually requires that party to pay the full amount up front, like a down payment or bank guarantee. The ‘money’ is for the duration of the contract locked within the contract. However, it is also possible that the contract involves periodic payments, and that it attempts to make a payment after each period, without requiring advance payment.

⁷ See the example Safe Remote Purchase at solidity.readthedocs.io/en/develop/solidity-by-example.html#safe-remote-purchase

In order to provide the requisite functionality needed by contract practice, the smart contract system needs to be able to interact with the outside world, otherwise it could only operate with conditional payments and signals of the users.

The smart contract environment needs to allow smart contracts to *send* signals to external entities or objects, such as computers or robots, whereby the smart contract can operate in the real world without human intervention. An example would be a hotel room that unlocks once you make the payment for the room.

Furthermore the contract needs to be able to *receive* signals from the outside world. The facility to receive inputs has been christened 'oracles'. An 'oracle' is simply the entity or communication channel by which the smart contract system receives information about the external world.⁸ I will distinguish three kinds of oracles: automated oracles, TTP oracles, and expert oracles.

An example of an automated oracle is an self-driving car that sends a signal if it registers that it has been involved in an accident. Other examples are input/output devices, sensors etcetera, connections to websites or the Internet at large.

An oracle could also be connected to a human individual, who thereby functions as a trusted third party (TTP). An example is the courier who signals that he has delivered the package to the address specified. This offers a means whereby the smart contract system can obtain information about a state of affairs that is fairly complex to determine.

An oracle may offer even more complex services, in particular take an evaluative role, such as assessment of damage or quality of delivered goods. This may amount to an expert evaluation, such as exist in international trade. These have varied names, such as surveyor, certification agency, conformity assessment body. It may also amount to providing judgement. The oracle thereby functions as an arbiter or judge. Although at present such an oracle can only be fulfilled by a human expert, it is possible that in the future sufficiently advanced algorithms could fulfill a similar role. The smart contract may outsource specific balancing judgements that are hard if not impossible to program, and in that way may be able to make the smart contract as a whole more fair or just.

⁸ MIK, JLIT 2017, p. 21-24 points out that smart contracts therefore require trust in these oracles.

3. The law on excuses for non-performance

3.1. Introduction

When parties conclude a contract, we may presume that they do so with the expectation that the obligations from the contract are to be performed.⁹ We may for the sake of the present analysis disregard the idea that a contract is simply a promise to pay damages if it is not performed.¹⁰ Indeed, it can be argued that smart contracts are useful precisely because they offer a means to ensure that the contract is actually going to be performed.¹¹ The right of the creditor to performance is, however, not absolute. Every legal system recognises that the performance may be frustrated in various ways, without thereby making the debtor liable for breach of contract. These possibilities can be discussed under the general heading of ‘excuses’.

The law of excuses for non-performance is the result of a long and complicated history.¹² There used to be a variety of specific solutions in various jurisdictions, but scholarship and recent codifications have led to a closer approximation of the national rules.¹³ I will argue that the differences can be disregarded for the purpose of implementation in smart contracts, and that we can assume a essential functional similarity.

3.2. Excuses and the DCFR

One of the main principles of contract law is that the debtor has to perform the obligations that he has undertaken in the contract, and that he is liable for non-performance. The creditor may obtain damages, or ask for an order for specific performance, or terminate the contract. The liability of the debtor is, however, limited

⁹ See about this issue J.M. SMITS, D. HAAS & G. HESEN (eds), *Specific Performance in Contract Law: National and Other Perspectives* (Antwerpen: Intersentia 2008).

¹⁰ As stated by Oliver Wendell Holmes, but not really accepted anymore, see J. CARTWRIGHT, *Contract Law* (Oxford: Bloomsbury, 3rd ed. 2016), p. 273.

¹¹ RASKIN 2017.

¹² F. RANIERI, *Europäisches Obligationenrecht* (Vienna: Springer, 3rd ed., 2009), Ch. 6.

¹³ See the comparative work in H. BEALE, B. FAUVARQUE-COSSON, J. RUTGERS, D. TALLON & S. VOGENAUER (eds), *Cases, Materials and Text on Contract Law* (Oxford: Oxford University Press, 2nd ed., 2010), Ch. 12, 19, 23-25, M. SCHMIDT-KESSEL & K. MAYER, ‘Supervening events and force majeure’, in: J.M. Smits (ed.), *Elgar Encyclopedia of Comparative Law* (Cheltenham: Elgar, 2nd ed., 2012), p. 839, H. KÖTZ, *European Contract Law* (Oxford: Oxford University Press, 2nd ed., 2017), chapters 12, 14 and 15.

insofar as the non-performance has a cause for which he is not responsible and for which he should not be held accountable. This should not be assumed too quickly: while the debtor may not be accountable directly for theft by a third party, he may still be accountable for the loss of a good if he could have taken further preventive measures against theft. Non-accountability is mostly assumed only in cases of overpowering circumstances, which are generally called *force majeure*.

However, even if the debtor is not accountable for the cause, the non-performance may still have consequences. This applies in particular if performance is temporarily or permanently impossible. In that case the creditor cannot obtain an order for specific performance of the obligation, but this does not block other remedies. He may at the very least withhold performance, and terminate the contract,¹⁴ depending on the precise circumstances. Furthermore, impossibility itself does not rule out that the impossibility was due to a cause for which the debtor was accountable, in which case damages may be awarded. Hence the available remedies in case of impossibility may be quite like those for excuses in general, although not identical. The interplay between impossibility and excuses has in the past led to complicated rules and exceptions.¹⁵ Modern legal systems have fortunately managed to reach an appropriate solution by distinguishing clearly between the attributability of the cause of non-performance, and the available remedies (liability, termination). Impossibility is thereby relegated to being a particular kind of cause of non-performance, a potential excuse for certain remedies.

Part of the development of impossibility was the recognition of various kinds of impossibility.¹⁶ Besides factual impossibility (such as delivery of a painting that was destroyed by fire) and practical impossibility (such as delivery of a ring that had sunk to the bottom of the ocean), the law sometimes recognises moral impossibility (for example, the actor who refuses to perform as he has to attend the death bed of his wife). Closely related is the case that the obligation could only be performed by the debtor in violation of some legal prohibition (for example prohibition of exporting

¹⁴ KÖTZ, *European Contract Law*, Ch. 13.

¹⁵ RANIERI, *Europäisches Obligationenrecht*, Ch. 6.

¹⁶ KÖTZ, *European Contract Law*, p. 206-207.

currency); thereby the doctrines of illegality and public policy (which may invalidate the whole contract) are related to moral impossibility.

Art. III-3:104 DCFR captures the modern understanding of contractual excuses. It describes the general rule for excuses: these are impediments to performance which are beyond the debtor's control and could not be reasonably be expected to have been avoided or overcome. The criteria of this article may be interpreted as a redefinition of the general requirement of attribution of impediments. The article seems to focus particularly on impossibility, as it only provides specific rules for temporary and permanent impediments (art. III-3:104(3) and (4) DCFR).

A relevant distinction has to be made between obligations of result and obligations of means (obligations to observe reasonable care and skill).¹⁷ For the breach of the latter kind of obligation there is no valid excuse: one cannot excuse a lack of care or skill. The practical problem is rather how to prove the breach of the obligation. I will therefore disregard obligations of means as not relevant for the present topic.¹⁸

Important in practice is that parties may contractually agree on which causes are or are not legally attributable to the debtor, by way of a force majeure clause.¹⁹ Such a clause makes it easier to determine whether an impediment is a valid excuse, and allows parties to allocate contractual risks in a way they find appropriate.

In case of non-performance the law generally requires the creditor to notify the debtor of the non-performance. This warns the debtor (who may not even know of the non-performance, for example if a package has not been delivered) and allows him to remedy this. Notification furthermore allows the debtor to argue that the non-performance is due to an impediment outside his control, which constitutes *force majeure*. During this discussion, the creditor may withhold performance, which in essence means that he deliberately does not perform a counterobligation to enforce his right to the non-performed obligation (art. III-3:401 DCFR).

The outlines of the law as described by the DCFR can be traced also in modern codifications.

¹⁷ KÖTZ, *European Contract Law*, p. 246-251, T.F.E. TJONG TJIN TAI, 'Professional diligence and the UCP Directive', *European Review of Contract Law* 12/1 (2016), p. 1-20.

¹⁸ MIK, JLIT 2017, p. 21 finds such obligations not suitable for programming in smart contracts.

¹⁹ Explicated in the comments: DCFR, Vol. 1, p. 783 (Comments A. General).

3.3. German law

German contract law has been modified extensively in 2002.²⁰ In the original Bürgerliches Gesetzbuch (BGB) the main category of excuses was impossibility, which was quickly found to be too limited for a fair distribution of contractual risks. Since the reform of German contract law in 2002, the BGB offers rules for excuses besides impossibility. The main rules are as follows:

- the creditor has no claim to performance if this is impossible for the debtor or for anyone (§ 275(1) BGB).²¹
- the debtor may (even in case of impossibility)²² have to pay damages for breach of obligation, except if he is not responsible (*nicht zu vertreten*) for the breach (§ 280(1) BGB, cf. 286(4) BGB)
- the creditor may terminate (*Rücktritt*) the contract in case of breach, even if the debtor is not responsible (§ 323 BGB).

The liability for damages is therefore fault-dependent,²³ but termination is available regardless of responsibility for the breach.

As regards the responsibility of the debtor, this is determined according to § 276-278 BGB. The debtor is liable for intentional and negligent non-performance (§ 276 BGB), as well as for auxiliaries (§ 278 BGB). He is not liable for obstacles to performance that were not foreseeable and for which he has also not taken on the risk.²⁴ Parties may, however, make differing contractual arrangements.²⁵

3.4. French law

French contract law has recently been recodified,²⁶ which has significantly clarified the doctrine of excuses. In case of non-performance, the creditor may invoke several remedies, including termination and damages (art. 1217 Cc). However, damages are

²⁰ B.S. MARKESINIS, H. UNBERATH, A. JOHNSTON, *The German Law of Contract: A Comparative Treatise* (Oxford: Hart 2006), also S. GRUNDMANN, 'Germany and the Schuldrechtsmodernisierung 2002', *European Review of Contract Law* 2005/1, p. 129-148.

²¹ MARKESINIS, *German Law*, p. 406

²² § 283 BGB, MARKESINIS, *German Law*, p. 456.

²³ MARKESINIS, *German Law*, p. 444.

²⁴ Bamberger Kommentar 3rd ed. (Unberath) § 280 rdnr. 34, also § 286, nr. 51-59.

²⁵ Unberath § 286, nr. 52. It is also possible to assume the risk, by a 'Garantie' (Münchener Kommentar (W. Ernst), 5th ed., München: Beck 2007), § 280, nr. 24).

²⁶ 1 October 2016, see Ordonnance n° 2016-131 du 10 février 2016.

not due in case of *force majeure*,²⁷ when there is an event that impedes the performance of the obligation, which escapes the control of the debtor, and which could not reasonably be foreseen at the conclusion of the contract, and of which the effects cannot be evaded through appropriate measures (art. 1218(1) Cc).²⁸ Force majeure includes impossibility, as is clear from art. 1282(2) Cc, where it is stated that temporary impossibility may lead to suspension of the contractual obligation, except if it is of such a nature that it may justify termination. An exception to the duty to performance is withholding performance, ‘refuser d’exécuter ou suspendre l’exécution de sa propre obligation’ (art. 1217 and 1219 Cc).

3.5. English law²⁹

English contract law on excuses takes as its basis that liability for breach is strict.³⁰ The justification for strict liability in contract is that the debtor voluntarily accepted the obligation. However, not all contractual liability is strict. For example, in the case of a services involving an obligation of reasonable care, the debtor is only liable for breach if it is established that he was at fault.³¹ This, in effect, is the distinction between obligations of result and obligations of means (s. 3.2).

The general doctrine of an exception to strict liability is called frustration.³² In the leading case *Davis Contractors Ltd v Fareham Urban District Council* [1956] UKHL 3,³³ it is described as follows: “frustration occurs whenever the law recognises that, without the default of either party, a contractual obligation has become incapable of being performed because the circumstance in which performance is called for would render it a thing radically different from that which was undertaken by the contract.

²⁷ Art. 1231-1 Cc.

²⁸ ‘lorsqu’un événement échappant au contrôle du débiteur, qui ne pouvait être raisonnablement prévu lors de la conclusion du contrat et dont les effets ne peuvent être évités par des mesures appropriées, empêche l’exécution de son obligation par le débiteur.’

²⁹ *Chitty on Contracts*, vol. I (London: Thomson Reuters, 36th ed. 2015).

³⁰ N. ANDREWS, *Contract rules: decoding English law* (Antwerp: Intersentia 2016), p. 266, SMITH, *Law of Contract*, p. 170-171, E. MCKENDRICK, *Contract Law* (Oxford: Oxford University Press, 7th ed. 2016), p. 749, KÖTZ, *European Contract Law*, p. 252-254.

³¹ E. MCKENDRICK, *Contract Law*, p. 750, SMITH, *Atiyah’s Introduction*, p. 170-171.

³² J. CARTWRIGHT, *Contract Law* (Oxford: Bloomsbury, 3rd ed. 2016), p. 261, N. ANDREWS, *Contract rules*, p. 266, S.A. SMITH, *Atiyah’s Introduction to the Law of Contract* (Oxford: Clarendon, 6th ed. 2006), p. 167-169, 182-192.

³³ AC 696 (HL).

Non haec in foedera veni. It was not this that I promised to do.”³⁴ This includes cases where the underlying purpose of the contract has been defeated.³⁵ The supervening event may not be self-induced.³⁶

The literature shows various attempts at categorization. Categories of frustration that are generally recognised are impossibility³⁷ (including moral³⁸ or practical impossibility³⁹), frustration of purpose,⁴⁰ supervening illegality,⁴¹ hardship.⁴² Because contractual liability is strict, it is not necessary to have a general doctrine of force majeure, in contrast to civil law systems where it has to be decided on a case by case basis whether a certain cause constitutes force majeure. In English law, everything is attributable except if it is covered by a specific force majeure clause, or is one of the (other) excuses discussed above. There is not a single factor which is decisive for frustration; courts use a ‘multi-factorial’ approach’.⁴³

A contract can contain a force majeure clause,⁴⁴ releasing a party from its obligations for certain rare events, whereby parties have allocated the risk to a specific party.⁴⁵ Such a clause may be viewed as a species of frustration or a valid excuse,⁴⁶ or alternatively as not being part of frustration.⁴⁷ Force majeure clauses are interpreted narrowly, and in particular cannot be invoked when the event in the clause is caused by the negligence of the party relying upon the clause.⁴⁸

³⁴ Lord Radcliffe, [1956] AC 696, 728-9.

³⁵ N. ANDREWS, *Contract rules*, p. 257. This is analogous with the German notion of *Wegfall der Geschäftsgrundlage*.

³⁶ *Maritime National Fish Ltd v Ocean Trawlers Ltd* [1935] UKPC 1, J. CARTWRIGHT, *Contract Law*, p. 265, N. ANDREWS, *Contract rules*, p. 259, E. MCKENDRICK, *Contract Law*, p. 708.

³⁷ SMITH, *Atiyah's Introduction*, p. 183, E. MCKENDRICK, *Contract Law*, p. 715. See *Taylor v Caldwell* [1863] EWHC QB J1.

³⁸ This may also be said to include illegality, cf. N. ANDREWS, *Contract rules*, p. 252.

³⁹ Cf. N. ANDREWS, *Contract rules*, p. 253.

⁴⁰ E. MCKENDRICK, *Contract Law*, p. 716. SMITH, *Atiyah's Introduction*, p. 184 speaks of frustration of the common venture.

⁴¹ Considered as separate category by E. MCKENDRICK, *Contract Law*, p. 715, CHITTY ON CONTRACTS, nr. 23-024.

⁴² SMITH, *Atiyah's Introduction*, p. 187.

⁴³ E. MCKENDRICK, *Contract Law*, p. 702, referring to *Edwinton Commercial Coproration v Tsavliris Russ* [2007] EWCA Civ 547.

⁴⁴ For example see *Great Elephant v. Trafigura Beheer BV and Others (Crudesky)* [2013] EWCA Civ 905.

⁴⁵ N. ANDREWS, *Contract rules*, p. 248.

⁴⁶ N. ANDREWS, *Contract rules*, p. 266, SMITH, *Atiyah's Introduction*, p. 188-189.

⁴⁷ J. CARTWRIGHT, *Contract Law*, p. 264, 269.

⁴⁸ E. MCKENDRICK, *Contract Law*, p. 714, referring to the leading case *J. Lauritzen A.S. v Wijsmuller B.V., (The Super Servant Two)* [1990] 1 Lloyd's Rep 1.

3.6. Analysis

The civil law systems discussed above follow the broad outlines of the DCFR regarding excuses.⁴⁹ German and French law operate with the notion of an impediment (cause of non-performance) and require responsibility or attributability. Although at first sight the common law approach in England seems to be rather different, it follows essentially the same structure. While common law starts from the presumption of attributability of the impediment ('strict liability'), there are several exceptions, such as impossibility and supervening illegality, while force majeure clauses allow further exceptions. In this way a substantial number of causes of non-performance do not lead to liability, which effectively is the same result as in civil law systems.

Hence there is sufficient ground to assume a general consensus on the law of excuses. In case of non-performance there are several ways in which the debtor may successfully excuse himself for the usual consequences of non-performance.⁵⁰ These excuses are categorised in various ways in different jurisdictions, but can for the purposes of the present research be lumped together as simply being causes for non-performance which may be excusable, or, in civil law terms, may be non-attributable. Even illegality or public order can be viewed as impediments (even though they may also lead to nullity of the contract). Most jurisdictions start from a presumption of attributability, in other words have a fairly strict regime of contractual liability.

Practical problems arise in case of multiple causes of non-performance, in particular if some causes can be attributed to the creditor as well, and in cases of temporary impossibility and/or repairable breach of an obligation. Here I cannot discuss these in depth.

4. Implementing excuses in smart contracts

4.1. Introduction

⁴⁹ Also KÖTZ, *European Contract Law*, p. 245.

⁵⁰ Besides the requirement of default, which is part of the doctrinal discussion on remedies and will not be discussed here.

An obvious approach is to try to translate or implement the legal rules in code.⁵¹ Insofar as smart contracts can easily accommodate the legal rules, there is no tension. Insofar as it may prove difficult to fully program the legal rules, the choice can be made either to emulate the rule as far as possible (possibly by outsourcing the legal assessment through an expert oracle), or to deviate from the law by replacing the rule with a simpler hard-and-fast rule. By taking the latter route, parties may lose some of the protection that the more complex or vague legal rule offers.

The general outline of the law of excuses is:

- find the cause of the non-performance, and
- determine whether the cause is attributable to the debtor.

I will focus on this two-step process.

4.2. Determining the cause of non-performance

The first step in programming excuses in a smart contract is to determine the cause of non-performance. Certain causes may be easy to foresee and program into the contract, in particular where these causes are part of the smart contract environment. An example might be insufficient balance of the cryptocurrency.⁵² Other causes may be external and may be more difficult to assess. Detecting such causes would require the use of an oracle. The (non)delivery of a package can for example be ascertained by the courier, who in that way functions as an oracle. If the non-delivery is a cause of non-performance, this offers a simple way of determining whether this cause is present. But other causes may be rarer, harder to foresee, detect, and code into the contract. Examples are strikes, bad weather, general break-down of Internet.

While it is theoretically possible that in time best practices develop by which smart contracts can simply include long lists of possible causes (s. 4.6), the determination of the cause is further complicated because dependent upon the kind of contract there may be different causes that are relevant, and different ways in which it can be ascertained that they occurred. A contract of sale has different causes of non-performance than a credit contract.

⁵¹ REYES, *Neb. LR* 2017, p. 415.

⁵² Although smart contracts usually require payment in advance which is only paid out to the other party when sufficient conditions are fulfilled, this is not always the case, such as in the example of periodic payment of a car lease.

This problem may be evaded by allowing a general exception of ‘force majeure’ which may be invoked by the debtor, and works by calling an expert oracle. Thereby the contract enlists the aid of an outside expert or adjudicator. This in effect simply means allowing ADR or ODR within the smart contract. The major disadvantage of this approach is that this effectively denies most of the benefits that smart contracts would have, in particular by breaking the automatic execution of the contract. For that reason I will not expand on this. Incidentally, invoking expert oracles also has the disadvantage that it may induce a disgruntled contract party to hold the oracle liable for a faulty opinion, or even threaten to do so, which could lead the oracle to delay his opinion until a clear court decision. This opens up a weakness in the supposed automatic enforcement of the contract.

A solution more in the spirit of smart contracts might be to operate similar to most legal systems and actual contracts, by starting from the presumption that breach is attributable, and only allowing a limited set of foreseeable relevant causes as an excuse. Any remaining, unforeseen causes would simply be at the risk of the debtor. This is not per se unfair, given the extensive attribution of causes in most jurisdictions. The debtor will usually be in the best position to identify possible impediments and take precautionary measures, and may decide which risks he won’t accept. The contractual force majeure clause is not really different from this.

A smart contract force majeure clause still has three complications: (i) determining what is the relevant cause, (ii) separating causes due to the creditor, and (iii) following proper procedure.

(i) A cause may be the consequence of an underlying, earlier cause. The non-delivery of a package may or may not be attributable, depending upon the reason why the package was not delivered: was this due to a strike, the non-acceptance of the package by the debtor, a flood or a war which made delivery impossible? Hence the non-delivery itself need not be the cause but only puts us on the trail for the actual cause! Indeed, there may be several factors which prima facie appear to be relevant causes: it may require sophisticated legal analysis to determine what is the actually relevant cause.

(ii) A further complication arises if one cause is attributable to the creditor (such as non-acceptance of the package): in that case there may be a valid excuse, even

if another contributing cause is attributable to the debtor. The non-acceptance in turn may be justified if, for example, the package clearly does not contain the item ordered (which might be visible because the package is too small). This brief analysis shows that even if some facts are clear, a further investigation may be required to determine whether there is not an underlying fact which changes whether the fact forms a valid excuse or not. This cannot be determined in the abstract. The determination of attributability is connected with determining the cause.

(iii) In actual legal practice there usually has to be a discussion between parties to determine the cause of non-performance: this process is captured in the rules regarding notification of non-performance.⁵³ Although such a dialogue may be programmed to some extent in a smart contract (as that can code communication between parties), this is hard to do in a predictable rule-based manner.⁵⁴ In a court procedure parties subsequently may take opposing positions regarding the relevant cause, and are required to provide proof, which allows the court to come to an informed decision on the identification of the actual cause. However, this whole process is ex-post, and does not help to code how the smart contract should behave during execution. Legal rules tend to take the court's perspective (ex post), and not the perspective of parties during execution of the contract (ex ante).⁵⁵

The above discussion shows that the developer of a smart contract would, if the contract involves significant monetary value, do well to make a thorough investigation of possibly relevant causes of breach, and possibilities of interaction between causes. Case law and doctrine may provide many examples. For simpler contracts or contracts with little monetary value, such an exercise may be needlessly thorough as parties may be willing to take the unknown risks of unforeseen causes of breach. For more complicated cases it is however hard to code all relevant possibilities of interacting causes and deal with these in a satisfactory way. To do so, it would be necessary to program a large part of a hypothetical procedural discussion into the smart contract. This seems at present practically impossible.

⁵³ See also art. III-3:104(5) DCFR.

⁵⁴ TJONG TJIN TAI, ICAIL 2017.

⁵⁵ As pointed out by WERBACH & CORNELL 2017, p. 361 and MIK, JLIT 2017, p. 17.

At first blush it seems only feasible to program (a) a list of easily identifiable possible causes that can be identified through normal automatic oracles, or can non-contestably be verified through simple TTP oracles, and (b) a presumption that such a cause, if present in a certain time-frame actually is the actual relevant cause of the non-performance. Multiple causality and impediments due to the creditor seem to be too difficult to deal with at present.

4.3. Determining the attributability of the cause

Assuming that the cause or causes of breach have been determined, the next step is to determine the attributability of the cause. Although the general rule of attributability in civil law systems is an open norm that requires judicial assessment and therefore is hard to program, in contractual practice the uncertainty of court discretion is usually (partly) bypassed by force majeure clauses, which spell out causes that count or do not count as force majeure. In principle such a clause could be programmed as a rule in a smart contract. However, there are two complications.

Firstly, contract practice can operate with fairly broad and open categories of causes.⁵⁶ In case of a dispute, parties and the court will be able to interpret the categories of causes and decide whether a specific state of affairs can be considered to be such a cause. Smart contracts, on the contrary, require precisely programmable definitions of causes.⁵⁷ To operationalise a cause it needs to be clearly defined. This may partly be solved by relying on a TTP oracle, but for more complicated cases an expert oracle would be required. This oracle would offer a binding decision as to whether there is force majeure. However, the effect is that the smart contract functions as a normal contract, where a dispute about attributability of a cause of non-performance is ultimately decided by an independent third party, typically a court or arbitration panel. This would be time consuming and would offer parties possibilities for inhibiting the execution of the smart contract, by invoking force majeure.

Secondly, attributability in practice is not only determined by looking at the specific cause in isolation: it may require taking into account other circumstances of the case. A strike may count as force majeure, but probably not if the strike is caused

⁵⁶ SKLAROFF 2017, p. 279-286, describing the benefits of using general standards in contracts.

⁵⁷ Cf. WERBACH & CORNELL 2017, p. 367 on the difficulty to program force majeure.

by clearly unacceptable and unnecessary behaviour by the debtor. The non-obtaining of a license may seem force majeure, but not if the debtor received two licenses for five boats and decided to allocate the licenses to boats other than the boat which was contracted about.⁵⁸

If we summarize this and the preceding section, we find that for force majeure we are left with a choice between either:

- a simple default rule that lists a number of circumstances that count as force majeure and that are identified through automated or TTP oracles, where causality is presumed (given a relevant time-frame), or
- a simple reference to an expert oracle.

Once it has been determined that there is in fact force majeure, the consequences can be programmed in a straightforward manner. Force majeure stands in the way of invoking a remedy for non-performance, as there is no breach. The creditor may, however, terminate the contract. Termination is also fairly easy to program (although it may require considerable legal acumen to correctly draft rules for everything that has to be arranged around and after termination, such as returning advance payments, valuation of partial performance).

4.4. Specific categories of excuses

The above analysis applies largely also to specific categories of excuses.

Impossibility can to a large extent be analysed similarly to force majeure. It is simply a specific kind of impediment. One difference between impossibility and force majeure, however, is that it is not common to find clauses that determine what counts as impossibility. This is insofar to be expected as absolute impossibility exists regardless of a contractual clause. However, for moral impossibility it could be feasible to add contractual rules. For a smart contract it will be necessary to add rules to determine the presence of impossibility.

A complication is that impossibility may have specific consequences that differ from excuses in general. Impossibility may have to be recognised as a specific kind of impediment. This may, however be difficult: as we already discussed it is hard to

⁵⁸ Maritime National Fish Ltd v Ocean Trawlers Ltd [1935] UKPC 1

explain in the abstract how to determine what is the relevant cause of non-performance, and similarly it is difficult to next determine whether such a cause forms an actual impediment which cannot be overcome in any way, as this may involve knowledge of the world in general. That the courier has an accident may lead to 'impossibility' if the package is broken, or may be overcome if it is a general item that can be sent by a new package. Similarly determining whether impossibility is temporary or permanent requires a sophisticated analysis which seems infeasible for a procedural programming language. At present such an analysis can only be realised through an expert oracle.

A smart contract alternative would be not to fully model the legal rules, but rather to only allow those forms of impossibility that have been programmed in the smart contract. This effectively means that all other forms of impossibility are at the risk of the debtor. Conversely, the contract might simply add that the debtor can always invoke impossibility. However, such a clause can be easily abused as the debtor thereby can invoke it whenever he does not feel like performing.

Actually determining when there is a case of impossibility is complicated as well. Some kinds of causes could be implemented in theory fairly well, such as a general breakdown of the Internet, but others might require complicated assessments of data or factual situations. Such cases would probably have to rely on TTP oracles, except if technological advances make automated algorithmic oracles more powerful.⁵⁹

For *illegality and public policy* again a complicated analysis would be required.⁶⁰ Given the rapid changes in the regulatory landscape concerning cryptocurrencies, the possibility of mandatory law prohibiting the conclusion or performance of certain contracts is far from theoretical. Determining whether there is a public prohibition requires a legal analysis, not a factual analysis of causes. The only practical way to incorporate this possibility in a smart contract is at present again to have an expert oracle, which may be called when a party invokes the excuse of illegality.

4.5. The limits of smart contracts and the evolution of excuses

⁵⁹ Such algorithms would then still have to connect to relevant sensors and data inputs, which is not a self-evident problem.

⁶⁰ Cf. WERBACH & CORNELL 2017, p. 372-373.

The above analysis is fairly pessimistic as to the possibility of fully capturing the complexities and protection that the doctrine of contractual excuses offers. This is in line with the position of Sklaroff, who argues that smart contracts shift the costs of contracting to the pre-contracting stage, as everything has to be drafted in the contract.⁶¹ Indeed, existing contractual practice benefits from vague standards, as this helps to reduce costs.⁶² In contrast, Casey and Niblett are optimistic and argue that smart contracts would not need excuses, as they would already have covered every eventuality as a condition.⁶³ However, they do not support their statement with a substantial analysis as the above.

To be true, there are two possible lines of defense against an overly pessimistic standpoint. First of all, the practical problems described above may partly be resolved by experience over time (and by learning from examples in case law). Given sufficient time it is possible that smart contract platforms would evolve best practices,⁶⁴ which would provide standard functions that contain standard provisions for most relevant and important kinds of impediments, allowing users to pick which they want or not. This would amount to a very extensive force majeure clause. Admittedly some issues (in particular multiple causation and determining the actual cause) may be too difficult to model completely (s. 4.2).

Secondly, it may be argued that algorithmic prediction may offer solutions for complex cases.⁶⁵ This assessment, again, seems overly optimistic: it ignores the current limitations of algorithms (which in essence do not much more than pattern-recognition and qualification), the extent of variation in actual contract practice, and the problem of multiple causality.

A more fundamental problem with the approach of smart contracts is that contract law is not about ex ante regulation (which is what smart contracts focus on), but rather is designed for ex post adjudication.⁶⁶ Furthermore, the well-known relational theory of contracting is at odds with the way in which smart contracts

⁶¹ SKLAROFF 2017, p. 292, referring to D. TAPSCOTT & A. TAPSCOTT, *Blockchain Revolution* 2016, p. 103.

⁶² SKLAROFF 2017, p. 293-295, MIK 2017, p. 19-20.

⁶³ CASEY & NIBLETT, 'Self-Driving Contracts', p. 24. The translation of excuses to contractual conditions is, from the point of view of the present analysis, irrelevant.

⁶⁴ WERBACH & CORNELL 2017, p. 374-375, PAECH 2017, p. 1097.

⁶⁵ CASEY & NIBLETT, 'Self-Driving Contracts', p. 24.

⁶⁶ S. 4.2.

perceive contracts.⁶⁷ Complex business situations involve relations which are only partially captured in contracts, and such relations need a kind of flexibility that is fundamentally at odds with the rigidity of smart contracts. Indeed, it appears that in business practice smart contracts may be used primarily for executing parts of a broader framework contract, such as financial securities and options. Used in this way there is nothing special about smart contracts, as they are only a mode of performance of a normal contract.

However, in situations where the relational view of contracting does not hold, there may be real benefits to smart contracts. An example is a remote purchase of little monetary value.⁶⁸ Such cases involve one-off transactions where no long-term relation is involved, while there is no practical possibility to invoke the protection of the law (due to costs and distance). It seems likely that parties may in such circumstances prefer to have only limited, actually enforceable remedies, instead of none at all. A hard-and-fast rule may therefore be acceptable here.

5. Conclusion

As the above analysis shows, smart contracts are not very well suited to deal with the finesses that are currently expected when it comes to excuses to performance. In particular problems of exhaustively coding causes, dealing with multiple causes, and attributing causes, are far more complicated than is feasible at present for straightforward coding. In case a party raises an excuse, the contract could either call the help of an expert oracle – which amounts to invoking arbitration, thereby acknowledging defeat of the purpose of smart contracts – or refusing to provide for the nuances of excuses in practice, which amounts to a hard-and-fast rule. Only by extensive development of best practices is improvement to be expected.

⁶⁷ WERBACH & CORNELL 2017, p. 367, Similarly K.E.C. LEVY, 'Book-Smart, Not Street-Smart: Blockchain-Based Smart Contracts and The Social Workings of Law', 3 *Engaging Science, Technology, and Society* 2017, p. 1-15.

⁶⁸ TJONG TJIN TAI, ICAIL 2017.